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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 10/030,656      | 01/11/2002  | Masaaki Hagihara     | 07553.0029          | 4656             |

7590

03/20/2003

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EXAMINER

OLSEN, ALLAN W

ART UNIT

PAPER NUMBER

1763

DATE MAILED: 03/20/2003

6

Please find below and/or attached an Office communication concerning this application or proceeding.

AS-6

|                              |                        |                 |  |
|------------------------------|------------------------|-----------------|--|
| <b>Office Action Summary</b> | <b>Applicant(s)</b>    | HAGIHARA ET AL. |  |
|                              | <b>Art Unit</b>        | 1763            |  |
|                              | <b>Applicant's N .</b> | 10/030,656      |  |
|                              | <b>Examiner</b>        | Allan W. Olsen  |  |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 11 January 2002.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-11 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-11 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11 January 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☒ All   b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                                    | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____  |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                           | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>3,5</u> . | 6) <input type="checkbox"/> Other: _____                                    |

## DETAILED ACTION

### *Priority*

Applicant has requested that the receipt of the priority documents be acknowledged. The examiner notes that a copy of the Japanese priority document 11-241427, with a stamped WIPO receipt date of 13 October 2000, is present in the application file wrapper

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

**Claims 1-3 and 5 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 6,380,096 issued to Hung et al. (hereinafter, Hung).**

Hung teaches using a plasma comprising CH<sub>2</sub>F<sub>2</sub> or CH<sub>3</sub>F and O<sub>2</sub> and Ar to etch a layer of silicon nitride that overlies a layer of copper. Hung teaches using a plasma comprising CH<sub>2</sub>F<sub>2</sub>, CH<sub>3</sub>F and O<sub>2</sub>. See column 3, lines 13-16; column 6, table 3; column 11, table 6; column 12, table 7.

**Claims 1, 4 and 5 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 6,162,0583 issued to Yang et al. (hereinafter, Yang).**

Yang teaches using a plasma comprising CH<sub>2</sub>F<sub>2</sub> or CH<sub>3</sub>F and O<sub>2</sub> and Ar to etch a layer of silicon nitride that overlies a layer of copper. Hung teaches using a plasma comprising CHF<sub>3</sub>, Ar and O<sub>2</sub>. See column 4, lines 1-13; column 6, lines 11-55.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claims 6-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,093,632 issued to Lin, in view of Wong et al in Journal of Vacuum Science and Technology (hereinafter, Wong).**

Lin teaches using a plasma comprising a hydrofluoromethane (i.e. CH<sub>3</sub>F, CH<sub>2</sub>F<sub>2</sub> or CHF<sub>3</sub>) to etch a layer of silicon nitride that overlies a layer of copper. The silicon nitride that is etched is that portion of a silicon nitride layer that is exposed through the openings of an overlying patterned photoresist. See column 4, line 4 - column 6, line 8.

Lin does not teach adding O<sub>2</sub> to the hydrofluoromethane etchant.

Wong teaches etching silicon nitride with a plasma comprising CHF<sub>3</sub> and O<sub>2</sub>.

It would have been obvious to one skilled in the art to add O<sub>2</sub> to Lin's hydrofluoromethane etchant because Wong teaches that the quality of the etched features can be improved substantially by adding a small amount of O<sub>2</sub> to a CHF<sub>3</sub> plasma. See the right column of pages 2394 and 2395.

**Claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin and Wong as applied to claim 6 above, and further in view of Hung.**

The Lin/Wong combination does not teach adding an inert gas to the nitride etchant and nor does it teach conducting the nitride etch, the photoresist ashing and the H<sub>2</sub> etching steps within the same chamber.

Hung teaches adding an inert gas to the nitride etchant mixture of the Lin/Wong combination. Hung teaches that multiple steps may be carried out within the same plasma chamber. See: column 6, lines 46-53; column 7, lines 35-58; column 10, lines 68-63

It would have been obvious to one skilled in the art to add argon to the etchant of Lin because Hung teaches that the well known and widely used practice of adding an inert helps improve the anisotropy of the etching process. The examiner takes Official Notice that use of an inert gas diluent is well known to provide many additional advantages, such as, improving the safety of the process and improving the operators control over the ratio between reactive components of the etchant gas mixture.

It would have been obvious to one skilled in the art to conduct the nitride etch, the photoresist ashing and the H<sub>2</sub> etching steps within the same chamber because Hung teaches that the practice of carrying out a multistep process within a single chamber, also referred to as an in-situ integrated process, can significantly increase the efficiency of the overall process.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is 703-306-9075.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck, can be reached on 703-308-2333.

The general fax numbers for TC1700 are 703-872-9310 (non-after finals) and 703-872-9311(after-final).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0661.

Allan Olsen, Ph.D.  
March 17, 2003

A handwritten signature in black ink, appearing to read "Allan Olsen". The signature is stylized, with the first name "Allan" written in a cursive-like script and the last name "Olsen" in a more formal, slightly larger script.